

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: February 7, 2020

TO: Lisa Creegan – SER

FROM: Wade Strickland – WY/3

SUBJECT: Water Quality-Based Effluent Limitations for the Mukwonago Wastewater Treatment Plant
WPDES Permit No. WI-0020265-10

This is in response to your request for an evaluation of the need for water quality-based effluent limitations (WQBELs) using Chapters NR 102, 104, 105, 106, 207, 210, 212, and 217 of the Wisconsin Administrative Code (where applicable), for the discharge from the Village of Mukwonago Wastewater Treatment Plant in Waukesha County. This municipal wastewater treatment plant (WWTP) discharges to the Fox (IL) River, located in the Upper Fox Watershed in the Fox (IL) River Basin. The evaluation of the permit recommendations is discussed in more detail in the attached report.

The following recommendations are made on a chemical-specific basis at Outfall 001:

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Six-Month Average	Footnotes
Flow Rate						1,2
CBOD ₅			40 mg/L	25 mg/L		1
TSS			45 mg/L	30 mg/L		1
pH	9.0 s.u.	6.0 s.u.				1
Ammonia Nitrogen November – March April	20 mg/L 20 mg/L		20 mg/L 20 mg/L	20 mg/L 20 mg/L		3,4
Fecal Coliform May – September			656#/100 mL geometric mean	400#/100 mL geometric mean		3
Phosphorus AM Interim Limits Final				1.0 mg/L 0.300 mg/L	0.6 mg/L 0.100 mg/L 1.25 lbs/day	5
Nitrite + Nitrate						2,6
Nitrogen, Total Kjeldahl						2,6
Total Nitrogen						2,6
Acute WET						7,8
Chronic WET				4.5 TU _c		7,9

Footnotes:

1. No changes from the current permit
2. Monitoring only
3. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and NR 205.065(7) are included in bold.
4. In addition to the ammonia nitrogen limits, monitoring is recommended May – October each year.

5. Under the phosphorus Adaptive Management (AM) Plan, the interim limits (and technology-based limit (TBL)) of 1.0 mg/L as a monthly average and 0.6 mg/L as a six-month average should be effective upon permit reissuance.
6. As recommended in the Department's October 1, 2019 Guidance for Total Nitrogen Monitoring in WPDES Permits, quarterly total nitrogen (ammonia, organic and nitrate/nitrite) monitoring is recommended for all municipal major permittees. Total Nitrogen is the sum of nitrate (NO₃), nitrite (NO₂), organic nitrogen and ammonia (all expressed as N).
7. A minimum of annual acute and chronic monitoring is recommended because Mukwonago is a major municipal discharger with a design flow greater than 1.0 MGD. Federal regulations at 40 CFR Part 122.21(j) require at least 4 acute and chronic WET tests with each permit application on samples collected since the previous reissuance. Therefore, annual monitoring is recommended in the permit term, so that data will be available for the next permit application. Sampling WET concurrently with any chemical-specific toxic substances is recommended. Tests should be done in rotating quarters, to collect seasonal information about this discharge and should continue after the permit expiration date (until the permit is reissued).
8. According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), a synthetic (standard) laboratory water may be used as the dilution water and primary control in acute WET tests.
9. According to the requirements specified in s. NR 106.08, Wis. Adm. Code, a chronic WET limit is required. The chronic WET limit shall be expressed as 4.5 TUc as a monthly average in the effluent limits table of the permit. The Instream Waste Concentration (IWC) to assess chronic test results is 22%. According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), chronic testing shall be performed using a dilution series of 100%, 75%, 50%, 25% & 12.5% and the dilution water used in WET tests conducted on Outfall 001 shall be a grab sample collected from the Fox (IL) River, upstream of the outfall.

Please consult the attached report for details regarding the above recommendations. If there are any questions or comments, please contact Nicole Krueger at (414) 263-8650 (Nicole.Krueger@wisconsin.gov) or Diane Figiel at (608) 264-6274 (Diane.Figiel@wisconsin.gov).

Attachments (3) – Narrative, Thermal Table & Outfall Map

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Attachment #1
**Water Quality-Based Effluent Limitations for
Mukwonago Wastewater Treatment Plant**

WPDES Permit No. WI-0020265-10

Prepared by: Nicole Krueger

PART 1 – BACKGROUND INFORMATION

Facility Description:

The Village of Mukwonago wastewater treatment plant (WWTP) serves a population of 7300 and has no significant industry. The facility is a conventional activated sludge WWTF that went online in 1981 with substantial improvements in 2006 and 2007. Processes include mechanical fine screening, grit removal, primary clarification, aeration with fine bubble aeration tanks, final clarification, and Ultraviolet light for seasonal disinfection. The aeration basins contain an Integrated Fixed Film Activated Sludge (IFAS) system for the improvement of the biological process. Ferric chloride was added to the aeration basins for phosphorus removal until mid-2018 when the facility switched to using polyaluminum chloride. Effluent is pumped out of a clear well to the Fox (IL) River approximately 5,000 ft east of the WWTP.

Attachment #3 is a map of the area showing the approximate location of Outfall 001.

Existing Permit Limitations: The current permit, expiring on 03/31/2020, includes the following effluent limitations and monitoring requirements.

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Six-Month Average	Footnotes
Flow Rate						1
CBOD ₅			40 mg/L	25 mg/L		
TSS			45 mg/L	30 mg/L		
pH	9.0 s.u.	6.0 s.u.				2
Ammonia Nitrogen November – April	20 mg/L					
Fecal Coliform May – September				400#/100 mL geometric mean		
Phosphorus				1.0 mg/L		3
Temperature Maximum						1

Footnotes:

1. Monitoring only.
2. These limitations are not being evaluated as part of this review. Because the water quality criteria (WQC), reference effluent flow rates, and receiving water characteristics have not changed, limitations for these water quality characteristics do not need to be re-evaluated at this time.
3. This is an interim limit. The final WQBEL is 0.100 mg/L as six-month average and 0.300 mg/L as a monthly average. A compliance schedule is in the current permit to meet the final WQBEL by 04/01/2024.

Receiving Water Information:

- Name: Fox (IL) River (WBIC 742500)
- Classification used in accordance with chs. NR 102 and 104, Wis. Adm. Code: water sport fish community, non-public water supply.
- Low Flows used in accordance with chs. NR 106 and 217, Wis. Adm. Code: The following 7-Q₁₀ and 7-Q₂ values are from USGS for Station 05544304 at the mouth of the Mukwonago River, where Outfall 001 is located.

7-Q₁₀ = 33.0 cfs (cubic feet per second)

7-Q₂ = 57.0 cfs

90-Q₁₀ = 48.5 cfs

Harmonic Mean Flow = 98.1 cfs

The Harmonic Mean has been estimated based on average flow and the 7-Q₁₀ using an equation from U.S. EPA's *Technical Support Document for Water Quality-Based Toxics Control* (March 1991, EPA/505/2-90-001, pgs. 88-89).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-Q ₁₀ (cfs)	63	66	92	120	85	52	39	42	43	50	72	67
7-Q ₂ (cfs)	105	119	191	207	156	115	83	76	72	84	109	118

These flows were updated in December 2019. Previous permits used the following low flow values:

7-Q₁₀ = 26 cfs

7-Q₂ = 46 cfs

Harmonic Mean Flow = 91 cfs

- Hardness = 363 mg/L as CaCO₃. This value represents the geometric mean of data from WET tests from 05/24/2006 to 04/16/2019.
- % of low flow used to calculate limits in accordance with s. NR 106.06 (4) (c) 5., Wis. Adm. Code: 25%
- Source of background concentration data: Metals data from the Fox (IL) River at Station ID 683096 (at Highway I) is used for this evaluation. The numerical values are shown in the tables below. If no data is available, the background concentration is assumed to be negligible and a value of zero is used in the computations. Background data for calculating effluent limitations for ammonia nitrogen are described later.
- Multiple dischargers: None
- Impaired water status: The Fox (IL) River is listed as impaired for PCBs and Total Phosphorus at the point of discharge.

Effluent Information:

- Design Flow Rate(s):
Annual average = 1.5 MGD (Million Gallons per Day)
For reference, the actual average flow from 04/01/2015 to 08/31/2019 was 0.95 MGD.
- Hardness = 413 mg/L as CaCO₃. This value represents the geometric mean of data from the current permit application from 05/07/2019 as well as from the previous permit applications from 08/28/2008 to 09/08/2008 and 12/16/2013.
- Acute dilution factor used in accordance with s. NR 106.06 (3) (c), Wis. Adm. Code: Not applicable – this facility does not have an approved Zone of Initial Dilution (ZID).

Attachment #1

- Water Source: Domestic wastewater. The Village of Mukwonago adds Clearito (oxidant for iron bacteria control) to the water supply.
- Additives: Polyaluminum chloride for phosphorus removal.
- Effluent characterization: This facility is categorized as a major municipal, so the permit application required effluent sample analyses for all the “priority pollutants” except for the Dioxins and Furans as specified in s. NR 200.065, Table 1, Wis. Adm. Code.

Sample Date	Chloride mg/L	Sample Date	Chloride mg/L	Sample Date	Chloride mg/L
05/07/2019	480	06/13/2019	430	07/02/2019	420
05/10/2019	370	06/18/2019	480	07/08/2019	450
05/13/2019	470	06/24/2019	510	07/11/2019	510
05/16/2019	490	06/27/2019	480		
1-day P ₉₉ = 570 mg/L					
4-day P ₉₉ = 514 mg/L					

Sample Date	Mercury ng/L	Sample Date	Mercury ng/L	Sample Date	Mercury ng/L
05/07/2019	0.83	06/13/2019	0.77	07/02/2019	0.72
05/10/2019	0.96	06/18/2019	0.67	07/08/2019	0.74
05/13/2019	0.64	06/24/2019	1.4	07/11/2019	0.73
05/16/2019	0.67	06/27/2019	0.59		
1-day P ₉₉ = 1.5 ng/L					
4-day P ₉₉ = 1.1 ng/L					

	Copper µg/L
05/07/2019	3.2
05/10/2019	2.9
05/13/2019	3.5
05/16/2019	4.0
Average	3.4

In the permit application a single sample for cyanide was reported as 29 µg/L and additional data was requested. Five additional samples were analyzed which all resulted in no detects.

Effluent data for substances for which a single sample was analyzed is shown in the tables in Part 2 below, in the column titled “MEAN EFFL. CONC.”.

The following table presents the average concentrations and loadings at Outfall 001 from 04/01/2015 to 08/31/2019 for all parameters with limits in the current permit to meet the requirements of s. NR 201.03(6):

Attachment #1

	Average Measurement
CBOD ₅	3.65 mg/L*
TSS	7.54 mg/L
pH field	7.49 s.u.
Phosphorus	0.41 mg/L
Ammonia Nitrogen	2.20 mg/L*
Fecal Coliform	34.5 #/100mL*

*Results below the level of detection (LOD) were included as zeroes in calculation of average.

PART 2 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR TOXIC SUBSTANCES – EXCEPT AMMONIA NITROGEN

Permit limits for toxic substances are required whenever any of the following occur:

1. The maximum effluent concentration exceeds the calculated limit (s. NR 106.05(3), Wis. Adm. Code)
2. If 11 or more detected results are available in the effluent, the upper 99th percentile (or P₉₉) value exceeds the comparable calculated limit (s. NR 106.05(4), Wis. Adm. Code)
3. If fewer than 11 detected results are available, the mean effluent concentration exceeds 1/5 of the calculated limit (s. NR 106.05(6), Wis. Adm. Code)

Acute Limits based on 1-Q₁₀

Daily maximum effluent limitations for toxic substances are based on the acute toxicity criteria (ATC), listed in ch. NR 105, Wis. Adm. Code. Previously daily maximum limits for toxic substances were calculated as two times the ATC. However, changes to ch. NR 106, Wis. Adm. Code (September 1, 2016) require the Department to calculate acute limitations using the same mass balance equation as used for other limits along with the 1-Q₁₀ receiving water low flow to determine if more restrictive effluent limitations are needed to protect the receiving stream from discharges which may cause or contribute to an exceedance of the acute water quality standards.

$$\text{Limitation} = \frac{(\text{WQC}) (Q_s + (1-f) Q_e) - (Q_s - f Q_e) (C_s)}{Q_e}$$

Where:

WQC = Acute toxicity criterion or secondary acute value according to ch. NR 105

Q_s = average minimum 1-day flow which occurs once in 10 years (1-day Q₁₀)

if the 1-day Q₁₀ flow data is not available = 80% of the average minimum 7-day flow which occurs once in 10 years (7-day Q₁₀).

Q_e = Effluent flow (in units of volume per unit time) as specified in s. NR 106.06(4)(d), Wis. Adm. Code.

f = Fraction of the effluent flow that is withdrawn from the receiving water, and

C_s = Background concentration of the substance (in units of mass per unit volume) as specified in s. NR 106.06(4)(e), Wis. Adm. Code.

As a rule of thumb, if the receiving water is effluent dominated under low stream flow conditions, the 1-Q₁₀ method of limit calculation produces the most stringent daily maximum limitations and should be

Attachment #1

used while making reasonable potential determinations. This is not the case for Mukwonago WWTP and the limits are set based on two times the acute toxicity criteria.

The following tables list the calculated water quality-based effluent limitations for this discharge along with the results of effluent sampling for all the detected substances. All concentrations are expressed in terms of micrograms per Liter ($\mu\text{g/L}$), except for hardness and chloride (mg/L) and mercury (ng/L).

Daily Maximum Limits based on Acute Toxicity Criteria (ATC)

RECEIVING WATER FLOW = 20.8 cfs, ($1-Q_{10}$ (estimated as 80% of $7-Q_{10}$)), as specified in s. NR 106.06 (3) (bm), Wis. Adm. Code.

SUBSTANCE	REF. HARD.* mg/L	ATC	MEAN BACK-GRD.	MAX. EFFL. LIMIT**	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	1-day P_{99}	1-day MAX. CONC.
Arsenic		340	9.60	680	136	<1.0		
Cadmium	413	52.4	0.22	105	21.0	0.22		
Chromium	301	4446	3.77	8892	1778	<0.83		
Copper	413	59.2	6.07	118	23.7	3.40		
Lead	356	365	4.38	729	146	<4.3		
Mercury		830	0.20	1660		1.50		
Nickel	268	1080	1.22	2161	432	1.30		
Zinc	333	345	12.9	689	138	34.0		
Cyanide, Amenable		45.8		91.6	18.3	4.83		
Chloride (mg/L)		757		1514			570	510

* The indicated hardness may differ from the effluent hardness because the effluent hardness exceeded the maximum range in ch. NR 105, Wis. Adm. Code, over which the acute criteria are applicable. In that case, the maximum of the range is used to calculate the criterion.

** The $2 \times \text{ATC}$ method of limit calculation yields a more restrictive limit than consideration of ambient concentrations and $1-Q_{10}$ flow rates per the changes to s. NR 106.07(3), Wis. Adm. Code, effective 09/01/2016.

Weekly Average Limits based on Chronic Toxicity Criteria (CTC)

RECEIVING WATER FLOW = 6.50 cfs ($1/4$ of the $7-Q_{10}$), as specified in s. NR 106.06 (4) (c), Wis. Adm. Code

SUBSTANCE	REF. HARD.* mg/L	CTC	MEAN BACK-GRD.	WEEKLY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	4-day P_{99}
Arsenic		152	9.60	659	132	<1.0	
Cadmium	175	3.82	0.22	16.6	3.3	0.22	
Chromium	301	326	3.77	1470	294	<0.83	
Copper	363	31.2	6.07	121	24.1	3.40	
Lead	356	95.5	4.38	419	83.9	<4.3	
Nickel	268	120	1.22	543	109	1.30	
Zinc	333	345	12.9	1524	305	34.0	
Cyanide, Amenable		11.5		52.2	10.5	4.83	
Chloride (mg/L)		395		1799			514

* The indicated hardness may differ from the receiving water hardness because the receiving water hardness exceeded the maximum range in ch. NR 105, Wis. Adm. Code, over which the chronic criteria are applicable. In that case, the maximum of the range is used to calculate the criterion.

Attachment #1

Monthly Average Limits based on Wildlife Criteria (WC)

RECEIVING WATER FLOW = 9.78 cfs (¼ of the 90-Q₁₀), as specified in s. NR 106.06 (4), Wis. Adm. Code

SUBSTANCE	WC	MEAN BACK- GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P ₉₉
Mercury (ng/L)	1.3	0.20	7.02			0.89

Monthly Average Limits based on Human Threshold Criteria (HTC)

RECEIVING WATER FLOW = 21.8 cfs (¼ of Harmonic Mean), as specified in s. NR 106.06 (4), Wis. Adm. Code.

SUBSTANCE	HTC	MEAN BACK- GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.
Antimony	373		4312	863	0.25
Cadmium	370	0.22	4275	855	0.22
Chromium (+3)	3818000	3.77	44141160	8828232	<0.83
Lead	140	4.38	1572	315	<4.3
Nickel	43000	1.22	497125	99425	1.30
Cyanide, Total	9300		107520	21504	0.03

Monthly Average Limits based on Human Cancer Criteria (HCC)

RECEIVING WATER FLOW = 21.8 cfs (¼ of Harmonic Mean), as specified in s. NR 106.06 (4), Wis. Adm. Code.

SUBSTANCE	HCC	MEAN BACK- GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.
Arsenic	13.3	9.60	52.4	10.5	<1.0

In addition to evaluating the need for limits for each individual substance for which HCC exist, s. NR 106.06(8), Wis. Adm. Code, requires the evaluation of the cumulative cancer risk. Because effluent data is available for only one substance for which Human Cancer Criteria exists, and it was not detected in the effluent, determination of the cumulative cancer risk is not needed per s. NR 106.06(8), Wis. Adm. Code.

Conclusions and Recommendations: Based on a comparison of the effluent data and calculated effluent limitations, effluent limitations are not required for toxic substances, excluding ammonia which is discussed in Part 4.

**PART 3 – WATER QUALITY-BASED EFFLUENT LIMITATIONS
FOR COD₅ & TSS**

The weekly and monthly average CBOD₅ and TSS limits could potentially increase with the increase in the receiving water low flows. However, to allow an increase in a limit above an existing limit the facility must demonstrate the need for the higher limits consistent with s. NR 207.04(1), Wis. Adm. Code.

If Mukwonago would like to request an increase to the existing permit limits for CBOD₅ or TSS, an assessment of their effluent data consistent with the requirements of ss. NR 207.04(1)(a) and (c), Wis. Adm. Code, must be provided. This evaluation is on a parameter by parameter basis and includes consideration of operations, maintenance and temporary upsets. If the facility can successfully demonstrate the need for increased effluent limitations required in ch. NR 207, Wis. Adm. Code, then a

recalculation of the specific effluent limitation will be provided.

An initial review suggests that the requirements of s. NR 207.04(1)(a), Wis. Adm. Code, do not appear to be met based on CBOD₅ and TSS effluent concentrations based on data from 04/01/2015 to 08/31/2019. **Therefore, the current weekly and monthly average limits for CBOD₅ and TSS are required to be retained in the reissued permit consistent with s. NR 207.04(2), Wis. Adm. Code.**

PART 4 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR AMMONIA NITROGEN

The State of Wisconsin promulgated revised water quality standards for ammonia nitrogen in ch. NR 105, Wis. Adm. Code, effective March 1, 2004 which includes criteria based on both acute and chronic toxicity to aquatic life. The current permit has daily maximum limits. These limits are re-evaluated at this time due to the following changes:

- Subchapter IV of ch. NR 106, Wis. Adm. Code allows limits based on available dilution instead of limits set to twice the acute criteria.
- Section NR 106.07(3), Wis. Adm. Code requires weekly and monthly average limits for municipal treatment plants.
- There have been changes to the receiving water flow rates.

Daily Maximum Limits based on Acute Toxicity Criteria (ATC):

Daily maximum limitations are based on acute toxicity criteria in ch. NR 105, Wis. Adm. Code, which are a function of the effluent pH and the receiving water classification. The acute toxicity criterion (ATC) for ammonia is calculated using the following equation.

$$\text{ATC in mg/L} = [A \div (1 + 10^{(7.204 - \text{pH})})] + [B \div (1 + 10^{(\text{pH} - 7.204)})]$$

Where:

A = 0.411 and B = 58.4 for a Warm Water Sport fishery, and
pH (s.u.) = that characteristic of the effluent.

The effluent pH data was examined as part of this evaluation. A total of 1612 sample results were reported from 04/01/2015 to 08/31/2019. The maximum reported value was 8.20 s.u. (Standard pH Units). The effluent pH was 7.80 s.u. or less 99% of the time. The 1-day P₉₉, calculated in accordance with s. NR 106.05(5), Wis. Adm. Code, is 7.76 s.u. and the mean plus the standard deviation multiplied by a factor of 2.33, an estimate of the upper ninety ninth percentile for a normally distributed dataset, is 7.75 s.u. Therefore, a value of 7.80 s.u. is believed to represent the maximum reasonably expected pH, and therefore most appropriate for determining daily maximum limitations for ammonia nitrogen. Substituting a value of 7.80 s.u. into the equation above yields an ATC = 12.1 mg/L and a computed daily maximum limit of 24.3 mg/L.

This limit is greater than the current daily maximum limit of 20 mg/L for November – April. If Mukwonago would like to request an increase to the existing permit limits an assessment of their effluent data consistent with the requirements of ss. NR 207.04(1)(a) and (c), Wis. Adm. Code, must be provided. This evaluation is on a parameter by parameter basis and includes consideration of operations, maintenance and temporary upsets. Without a demonstration of need for a higher limit in accordance with s. NR 207.04, Wis. Adm. Code, the current limits must be continued in the reissued permit.

Potential changes to daily maximum Ammonia Nitrogen effluent limitations:

Attachment #1

Subchapter IV of ch. NR 106, Wis. Adm. Code (effective September 1, 2016) specifies methods for the use of the 1-Q₁₀ receiving water low flow to calculate daily maximum ammonia nitrogen limits if it is determined that the previous method of acute ammonia limit calculation (2×ATC) is not sufficiently protective of the fish and aquatic life. The more restrictive calculated limits shall apply.

The calculated daily maximum ammonia nitrogen effluent limits using the mass balance approach with the 1-Q₁₀ (estimated as 80 % of 7-Q₁₀) and the 2×ATC approach are shown below.

	Ammonia Nitrogen Limit mg/L
2×ATC	24.3
1-Q ₁₀	149

The 2×ATC method yields the most stringent limits for Mukwonago.

Weekly Average & Monthly Average Limits based on Chronic Toxicity Criteria (CTC)

Weekly and monthly average limits based on chronic toxicity criteria for ammonia are also calculated to determine the weekly and monthly average limits to meet the requirements of s. NR 106.07(3), Wis. Adm. Code.

Weekly average and monthly average limits for ammonia nitrogen are based on chronic toxicity criteria in ch. NR 105, Wis. Adm. Code. The 30-day chronic toxicity criterion (CTC) for ammonia in waters classified as a Warm Water Sport Fish Community is calculated by the following equation, according to subchapter IV of NR 106, Wis. Adm. Code.

$$CTC = E \times \{ [0.0676 \div (1 + 10^{(7.688 - pH)})] + [2.912 \div (1 + 10^{(pH - 7.688)})] \} \times C$$

Where:

pH = the pH (s.u.) of the receiving water,

E = 0.854,

C = the minimum of 2.85 or $1.45 \times 10^{(0.028 \times (25 - T))}$ – (Early Life Stages Present), or

C = $1.45 \times 10^{(0.028 \times (25 - T))}$ – (Early Life Stages Absent), and

T = the temperature (°C) of the receiving water – (Early Life Stages Present), or

T = the maximum of the actual temperature (°C) and 7 – (Early Life Stages Absent)

The 4-day criterion is equal to the 30-day criterion multiplied by 2.5. The 4-day criteria are used in a mass-balance equation with the 7-Q₁₀ (4-Q₃, if available) to derive weekly average limitations. And the 30-day criteria are used with the 30-Q₅ (estimated as 85% of the 7-Q₂ if the 30-Q₅ is not available) to derive monthly average limitations. The stream flow value is further adjusted to temperature; 100% of the flow is used if the Temperature ≥ 16 °C, 25% of the flow is used if the Temperature < 11 °C, and 50% of the flow is used if the Temperature ≥ 11 °C but < 16 °C.

Section NR 106.32 (3), Wis. Adm. Code, provides a mechanism for less stringent weekly average and monthly average effluent limitations when early life stages (ELS) of critical organisms are absent from the receiving water. This applies only when the water temperature is less than 14.5 °C, during the winter and spring months. Burbot, an early spawning species, are not believed to be present in the Fox (IL) River, based on conversations with local fisheries biologists. So “ELS Absent” criteria apply from October through March, and “ELS Present” criteria will apply from April through September for a warm water sport fish classification.

Attachment #1

Since minimal ambient data is available, the “default” basin assumed values are used for Temperature, pH and background ammonia concentrations, shown in the table below, with the resulting criteria and effluent limitations.

		April	May – September	October	November - March
Effluent Flow	Qe (MGD)	1.5	1.5	1.5	1.5
Background Information	7-Q ₁₀ (cfs)	33	33	33	33
	7-Q ₂ (cfs)	57	57	57	57
	Ammonia (mg/L)	0.09	0.07	0.10	0.17
	Temperature (°C)	9	18	13	2
	pH (s.u.)	7.78	7.87	7.96	7.81
	% of Flow used	25	25	100	50
	Reference Weekly Flow (cfs)	8.25	33	16.5	8.25
	Reference Monthly Flow (cfs)	12.1	48.5	24.2	12.1
Criteria mg/L	4-day Chronic				
	Early Life Stages Present	8.20	4.93		
	Early Life Stages Absent			7.15	12.7
	30-day Chronic				
	Early Life Stages Present	3.28	1.97		
	Early Life Stages Absent			2.86	5.09
Effluent Limitations mg/L	Weekly Average				
	Early Life Stages Present	37.0	74.1		
	Early Life Stages Absent			57.3	57.4
	Monthly Average				
	Early Life Stages Present	19.9	41.7		
	Early Life Stages Absent			31.7	30.8

Effluent Data

The following table evaluates the statistics based upon ammonia data reported from 04/01/2015 to 08/31/2019, with those results being compared to the calculated limits to determine the need to include ammonia limits in the Mukwonago permit for the respective month ranges. That need is determined by calculating 99th upper percentile (or P₉₉) values for ammonia during each of the month ranges and comparing the daily maximum values to the daily maximum limit. Based on this comparison, limits aren't required for any month because the P₉₉'s do not exceed the calculated limits.

Ammonia Nitrogen mg/L	April	May – September**	October	November – March
1-day P ₉₉	12.6	9.10	8.40	17.4
4-day P ₉₉	6.80	5.10	4.60	9.40
30-day P ₉₉	3.43	2.29	2.17	4.67
Mean*	2.04	1.13	1.19	2.75
Std	2.69	2.10	1.90	3.68
Sample size	86	416	73	345
Range	<0.159-12.9	<0.159-18.0	<0.159-11.6	<0.159-22.7

*Values lower than the level of detection were substituted with a zero

** The data from May 2015 was removed from this comparison because the facility was using a pesticide

Attachment #1

which killed the plant nitrifiers and increased the effluent ammonia unusually high. This period is not representative of normal operation, so the data was removed for this comparison.

Where there are existing ammonia nitrogen limits in the permit, the limits must be retained regardless of reasonable potential, consistent with s. NR 106.33(1)(b), Wis. Adm. Code:

(b) If a permittee is subject to an ammonia limitation in an existing permit, the limitation shall be included in any reissued permit. Ammonia limitations shall be included in the permit if the permitted facility will be providing treatment for ammonia discharges.

Conclusions and Recommendations:

In summary, after rounding to two significant figures, the following ammonia nitrogen limitations are recommended. Because Mukwonago is a municipal discharger, weekly and monthly average limits are required to be included in the reissued permit where there are daily maximum limits required. No mass limitations are recommended in accordance with s. NR 106.32(5), Wis. Adm Code.

	Daily Maximum mg/L	Weekly Average mg/L	Monthly Average mg/L
April	20	31	20
May – September	-	-	-
October	-	-	-
November – March	20	48	26

Additional limits to meet the requirements in s. NR 106.07, Wis. Adm Code, are addressed in the expression of limits section of this memo.

PART 5 –PHOSPHORUS

Technology Based Phosphorus Limit

Subchapter II of Chapter NR 217, Wis. Adm. Code, requires municipal wastewater treatment facilities that discharge greater than 150 pounds of Total Phosphorus per month to comply with a monthly average limit of 1.0 mg/L, or an approved alternative concentration limit. Because Mukwonago currently has a limit of 1.0 mg/L, this limit should be included in the reissued permit. This limit remains applicable unless a more stringent water quality-based concentration limit is given.

In addition, the need for a WQBEL for phosphorus must be considered.

Water Quality-Based Effluent Limits (WQBEL)

Revisions to administrative rules regulating phosphorus took effect on December 1, 2010. These rule revisions include additions to s. NR 102.06, Wis. Adm. Code, which establish phosphorus standards for surface waters. Subchapter III of NR 217, Wis. Adm. Code, establishes procedures for determining WQBELs for phosphorus, based on the applicable standards in ch. NR 102, Wis. Adm. Code.

Section NR 102.06(3)(a), Wis. Adm. Code, specifically names river segments for which a phosphorus criterion of 0.100 mg/L applies. For other stream segments that are not specified in s. NR 102.06(3)(a), Wis. Adm. Code, s. NR 102.06(3)(b), Wis. Adm. Code, specifies a phosphorus criterion of 0.075 mg/L. The phosphorus criterion of 0.100 mg/L applies for the Fox (IL) River.

Attachment #1

The conservation of mass equation is described in s. NR 217.13 (2)(a), Wis. Adm. Code, for phosphorus WQBELs and includes variables of water quality criterion (WQC), receiving water flow rate (Qs), effluent flow rate (Qe), and upstream phosphorus concentrations (Cs):

$$\text{Limitation} = [(WQC)(Q_s + (1-f) Q_e) - (Q_s - f Q_e) (C_s)]/Q_e$$

Where:

WQC = 0.100 mg/L for the Fox (IL) River

Qs = 100% of the 7-Q₂ of 57 cfs

Cs = background concentration of phosphorus in the receiving water pursuant to s. NR 217.13(2)(d), Wis. Adm. Code

Qe = effluent flow rate = 1.5 MGD = 2.3 cfs

f = the fraction of effluent withdrawn from the receiving water = 0

Section NR 217.13(2)(d), Wis. Adm. Code, specifies that the background phosphorus concentration used in the limit calculation formula shall equal the median of at least four samples collected during the months of May through October, and that all samples collected during a 28-day period shall be considered as a single sample and the average of these concentrations used to determine a median. Averaging begins at date of the first sample in the range of May through October.

A previous evaluation resulted in a WQBEL of 0.100 mg/L using a background concentration of greater than 0.1 mg/L. Section NR 217.13(2)(d) Wis. Adm. Code, states that the determination of upstream concentrations shall be evaluated at each permit reissuance. Additional data were considered in estimating the background phosphorus concentration.

A review of all available in stream total phosphorus data from 05/17/2016 to 10/16/2019 stored in the Surface Water Integrated Monitoring System database and collected by Mukwonago indicates that the median background total phosphorus concentration in the Fox (IL) River at Highway ES (Station ID #10046937) is 0.132 mg/L, approximately one mile upstream from the point of discharge. There were 45 samples collected, which ranged from 0.048 to 0.237 mg/L.

Substituting a background concentration above criteria into the limit calculation equation above would result in a calculated limit that is less than the applicable criterion of 0.100 mg/L. However, s. NR 217.13(7), Wis. Adm. Code, specifies that “if the water quality-based effluent limitation calculated pursuant to the procedures in this section is less than the phosphorus criterion specified in s. NR 102.06, Wis. Adm. Code, for the water body, the effluent limit shall be set equal to the criterion.”

Effluent Data

The following table summarizes effluent total phosphorus monitoring data from 04/01/2015 to 08/31/2019.

	Phosphorus mg/L
1-day P ₉₉	1.3
4-day P ₉₉	0.80
30-day P ₉₉	0.52
Mean	0.41
Std	0.24
Sample size	938
Range	0.08-3.28

Reasonable Potential Determination

The calculated WQBEL of 0.100 mg/L is less than the current technology-based limit of 1.0 mg/L, so the WQBEL must be included in the permit per s. NR 217.15(2), Wis. Adm. Code.

In accordance with s. NR 217.15(2), Wis. Adm. Code, there is reasonable potential for the discharge to cause or contribute to an exceedance of the water quality criteria. The data suggest that a compliance schedule will be necessary for the facility to meet the given phosphorus limits.

Limit Expression

According to s. NR 217.14 (2), Wis. Adm. Code, because the calculated WQBEL is less than or equal to 0.3 mg/L, the effluent limit of 0.100 mg/L may be expressed as a six-month average. If a concentration limitation expressed as a six-month average is included in the permit, a monthly average concentration limitation of 0.300 mg/L, equal to three times the WQBEL calculated under s. NR 217.13, Wis. Adm. Code. shall also be included in the permit. The six-month average should be averaged during the months of May – October and November – April.

Mass Limits

Because the discharge is to a surface water that is to or upstream of a phosphorus impaired water, a mass limit is also required, pursuant to s. NR 217.14(1)(a), Wis. Adm. Code. **This final mass limit shall be 0.100 mg/L × 8.34 × 1.5 MGD = 1.25 lbs/day expressed as a six-month average.**

Adaptive Management Interim Limit

Mukwonago intends to pursue adaptive management (AM) to comply with the phosphorus WQBELs. Because this is the first permit term in which AM is being pursued, the required interim limit is 0.6 mg/L, expressed as a 6-month average and 1.0 mg/L as a monthly average per s. NR 217. 18 (3) (e) 1, Wis. Adm. Code. The permittee may be allowed up to five years to meet this interim limit.

Mukwonago has shown the ability to meet the required interim limit. The facility switched to using polyaluminum chloride (PAC) on 07/19/2018 which has demonstrated better phosphorus removal than ferric chloride. The 30-day P₉₉ of effluent phosphorus data since the switch to PAC is 0.27 mg/L and the average is 0.22 mg/L. Because Mukwonago has demonstrated that they can meet the six-month AM interim limit of 0.6 mg/L, this interim limit is recommended to be effective upon permit reissuance.

PART 6 –THERMAL

Surface water quality standards for temperature took effect on October 1, 2010. These regulations are detailed in chs. NR 102 (Subchapter II – Water Quality Standards for Temperature) and NR 106 (Subchapter V – Effluent Limitations for Temperature) of the Wisconsin Administrative Code. Daily maximum and weekly average temperature criteria are available for the 12 different months of the year depending on the receiving water classification.

In accordance with s. NR 106.53(2)(b) Wis. Adm. Code, the highest daily maximum flow rate for a calendar month is used to determine the acute (daily maximum) effluent limitation. In accordance with s. NR 106.53(2)(c), Wis. Adm. Code, the highest 7-day rolling average flow rate for a calendar month is used to determine the sub-lethal (weekly average) effluent limitation. These values were based off actual flow reported from 12/01/2013 to 11/30/2019.

The table below summarizes the maximum temperatures reported during monitoring from 12/01/2013 to 11/30/2019.

Month	Representative Highest Monthly Effluent Temperature		Calculated Effluent Limit	
	Weekly Maximum	Daily Maximum	Weekly Average Effluent Limitation	Daily Maximum Effluent Limitation
	(°F)	(°F)	(°F)	(°F)
JAN	55	68	-	120
FEB	50	53	-	120
MAR	51	63	-	120
APR	54	55	-	120
MAY	58	59	117	120
JUN	63	64	-	120
JUL	66	68	-	113
AUG	68	69	-	120
SEP	68	68	-	120
OCT	65	67	113	120
NOV	59	60	-	120
DEC	54	56	-	120

Reasonable Potential

Permit limits for temperature are recommended based on the procedures in s. NR 106.56, Wis. Adm. Code.

- An acute limit for temperature is recommended for each month in which the representative daily maximum effluent temperature for that month exceeds the acute WQBEL. The representative daily maximum effluent temperature is the greater of the following:
 - The highest recorded representative daily maximum effluent temperature
 - The projected 99th percentile of all representative daily maximum effluent temperatures

Attachment #1

- A sub-lethal limitation for temperature is recommended for each month in which the representative weekly average effluent temperature for that month exceeds the weekly average WQBEL. The representative weekly average effluent temperature is the greater of the following:
 - (a) The highest weekly average effluent temperature for the month.
 - (b) The projected 99th percentile of all representative weekly average effluent temperatures for the month

Based on the available effluent data **no effluent limits or monitoring are recommended for temperature**. The complete thermal table used for calculation is attached in Attachment #2.

PART 7 – WHOLE EFFLUENT TOXICITY (WET)

WET testing is used to measure, predict, and control the discharge of toxic materials that may be harmful to aquatic life. In WET tests, organisms are exposed to a series of effluent concentrations for a given time and effects are recorded. Decisions below related to the selection of representative data and the need for WET limits were made according to ss. NR 106.08 and 106.09, Wis. Adm. Code. WET monitoring frequency and toxicity reduction evaluation (TRE) recommendations were made using the best professional judgment of staff familiar with the discharge after consideration of the guidance in the WET Program Guidance Document (2019).

- Acute tests predict the concentration that causes lethality of aquatic organisms during a 48 to 96-hour exposure. To assure that a discharge is not acutely toxic to organisms in the receiving water, WET tests must produce a statistically valid LC₅₀ (Lethal Concentration to 50% of the test organisms) greater than 100% effluent, according to s. NR 106.09 (2) (b), Wis. Adm Code.
- Chronic tests predict the concentration that interferes with the growth or reproduction of test organisms during a seven-day exposure. To assure that a discharge is not chronically toxic to organisms in the receiving water, WET tests must produce a statistically valid IC₂₅ (Inhibition Concentration) greater than the instream waste concentration (IWC), according to s. NR 106.09 (3) (b), Wis. Adm Code. The IWC is an estimate of the proportion of effluent to total volume of water (receiving water + effluent). The IWC of 22% shown in the WET Checklist summary below was calculated according to the following equation, as specified in s. NR 106.03(6), Wis. Adm Code:

$$\text{IWC (as \%)} = Q_e \div \{(1 - f) Q_e + Q_s\} \times 100$$

Where:

Q_e = annual average flow = 1.5 MGD = 2.3 cfs

f = fraction of the Q_e withdrawn from the receiving water = 0

Q_s = 1/4 of the 7- Q_{10} = 33.0 cfs \div 4 = 8.25 cfs

- According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), a synthetic (standard) laboratory water may be used as the dilution water and primary control in acute WET tests, unless the use of different dilution water is approved by the Department prior to use. The primary control water must be specified in the WPDES permit.
- According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), receiving water must be used as the dilution water and primary control in chronic WET tests, unless the use of different dilution water is approved by the Department prior to use.

Attachment #1

The dilution water used in WET tests conducted on Outfall 001 shall be a grab sample collected from the receiving water location, upstream and out of the influence of the mixing zone and any other known discharge. The specific receiving water location must be specified in the WPDES permit.

- Shown below is a tabulation of all available WET data for Outfall 001. Efforts are made to ensure that decisions about WET monitoring and limits are made based on representative data, as specified in s. NR 106.08 (3), Wis. Adm Code. Data which is not believed to be representative of the discharge was not included in reasonable potential calculations. The table below differentiates between tests used and not used when making WET determinations.

WET Data History

Date Test Initiated	Acute Results LC ₅₀ % (% survival in 100% effluent)				Chronic Results IC ₂₅ %				Footnotes or Comments
	<i>C. dubia</i>	Fathead minnow	Pass or Fail?	Used in RP?	<i>C. dubia</i>	Fathead Minnow	Pass or Fail?	Use in RP?	
05/24/1994	>100	>100	Pass	Yes	>52			No	1
12/07/1994		>100	Fail	Yes					
01/18/1995	>100	>100	Pass	Yes					
02/15/1995	>100	>100	Pass	Yes					
07/18/1995		>100	Fail	No	>52	>52	Pass	Yes	1
08/30/1995	>100	>100	Pass	Yes					
09/25/1995	>100	>100	Pass	Yes					
04/08/1997					39	>52	Pass	Yes	
10/28/1999	>100	>100	Pass	Yes					
07/26/2000	>100	>100	Pass	Yes					
04/05/2001	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
03/20/2002	>100	>100	Pass	Yes					
07/17/2003	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
10/11/2004	>100	>100	Pass	Yes					
07/28/2005	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
05/24/2006	>100	>100	Pass	Yes					
02/01/2007	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
08/06/2008	>100	>100	Pass	No					2
01/31/2012	>100	>100	Pass	Yes					
02/12/2019	>100	>100	Pass	Yes	40.1	>100	Pass	Yes	
04/16/2019	>100	>100	Pass	Yes	61.2	>100	Pass	Yes	
06/11/2019	>100	>100	Pass	Yes	45.6	>100	Pass	Yes	
08/06/2019	>100	>100	Pass	Yes	59	68.4	Pass	Yes	

Footnotes:

- Qualified or Inconclusive Data.* Data quality concerns were noted during testing which calls into question the reliability of the test results.
 - Tests done by S-F Analytical, July 2008 – March 2011.* The DNR has reason to believe that WET tests completed by SF Analytical Labs from July 2008 through March 31, 2011 were not performed using proper test methods. Therefore, WET data from this lab during this period has been disqualified and was not included in the analysis.
- According to s. NR 106.08, Wis. Adm. Code, WET reasonable potential is determined by multiplying the highest toxicity value that has been measured in the effluent by a safety factor, to predict the

Attachment #1

likelihood (95% probability) of toxicity occurring in the effluent above the applicable WET limit. The safety factor used in the equation changes based on the number of toxicity detects in the dataset. The fewer detects present, the higher the safety factor, because there is more uncertainty surrounding the predicted value. **WET limits must be given, according to s. NR 106.08(6), Wis. Adm. Code, whenever the applicable Reasonable Potential equation results in a value greater than 1.0.**

$$\text{Acute Reasonable Potential} = [(TU_a \text{ effluent}) (B)(AMZ)]$$

$$\text{Chronic Reasonable Potential} = [(TU_c \text{ effluent}) (B)(IWC)]$$

According to s. NR 106.08(6)(d), Wis. Adm. Code, TU_a and TU_c effluent values are equal to zero whenever toxicity is not detected (i.e. when the LC_{50} , IC_{25} or $IC_{50} \geq 100\%$).

Acute Reasonable Potential = $0 < 1.0$, reasonable potential is not shown, and a limit is not required.

$$\text{Chronic Reasonable Potential} = [(TU_c \text{ effluent}) (B)(IWC)]$$

TU_c (maximum) 100/ IC_{25}	B (multiplication factor from s. NR 106.08(5)(c), Wis. Adm. Code, Table 4)	IWC
100/39 = 2.56	2.1 Based on 6 detects	22%

$$[(TU_c \text{ effluent}) (B)(IWC)] = 1.18 > 1.0$$

Therefore, reasonable potential is shown for chronic WET using the procedures in s. NR 106.08(6) and representative data from 07/18/1994 to 04/16/2019.

Expression of WET limits

Chronic WET limit = $4.5 TU_c$ (monthly average)

The WET Checklist was developed to help DNR staff make recommendations regarding WET limits, monitoring, and other related permit conditions. The Checklist indicates whether acute and chronic WET limits are needed, based on requirements specified in s. NR 106.08, Wis. Adm. Code. The Checklist steps the user through a series of questions, assesses points based on the potential for effluent toxicity, and suggests monitoring frequencies based on points accumulated during the Checklist analysis. As toxicity potential increases, more points accumulate, and more monitoring is recommended to ensure that toxicity is not occurring. A summary of the WET Checklist analysis completed for this permittee is shown in the table below. Staff recommendations based on best professional judgment are provided below the summary table. For guidance related to reasonable potential and the WET Checklist, see Chapter 1.3 of the WET Guidance Document: <http://dnr.wi.gov/topic/wastewater/WETguidance.html>.

WET Checklist Summary

	Acute	Chronic
AMZ/IWC	Not Applicable. 0 Points	IWC = 22%. 0 Points
Historical Data	18 tests used to calculate RP. No tests failed. 0 Points	12 tests used to calculate RP. No tests failed. 0 Points
Effluent Variability	Little variability, no violations or upsets, consistent WWTF operations.	Same as Acute.

Attachment #1

	Acute	Chronic
	0 Points	0 Points
Receiving Water Classification	Full fish and aquatic life. 5 Points	Same as Acute. 5 Points
Chemical-Specific Data	Limits for 0 based on ATC; ammonia, cadmium, chloride, copper, cyanide, mercury, nickel, and zinc detected. Additional Compounds of Concern: 0 3 Points	Limits for 0 based on CTC; ammonia, cadmium, chloride, copper, cyanide, mercury, nickel, and zinc detected. Additional Compounds of Concern: 0 3 Points
Additives	0 Biocides and 0 Water Quality Conditioners added. P treatment chemical other than Ferric Chloride (FeCl ₃), Ferrous Sulfate (FeSO ₄), or alum used: Yes, poly aluminum chloride is used. 15 Points	All additives used more than once per 4 days. 15 Points
Discharge Category	0 Industrial Contributors. 0 Points	Same as Acute. 0 Points
Wastewater Treatment	Secondary treatment or better 0 Points	Same as Acute. 0 Points
Downstream Impacts	No impacts known. 0 Points	Same as Acute. 0 Points
Total Checklist Points:	23 Points	23 Points
Recommended Monitoring Frequency (from Checklist):	1x yearly	1x yearly
Limit Required?	No	Yes Limit = 3.8 TU _c
TRE Recommended? (from Checklist)	No	No

- After consideration of the guidance provided in the Department's WET Program Guidance Document (2019) and other information described above annual acute and chronic WET tests are recommended in the reissued permit. Tests should be done in rotating quarters to collect seasonal information about this discharge. WET testing should continue after the permit expiration date (until the permit is reissued).
- According to the requirements specified in s. NR 106.08, Wis. Adm. Code, a chronic WET limit is required. The chronic WET limit shall be expressed as 3.8 TU_c as a monthly average in the effluent limits table of the permit.
- A minimum of annual chronic monitoring is required because a chronic WET limit is required. Federal regulations in 40 CFR Part 122.44(i) require that monitoring occur at least once per year when a limit is present.
- A minimum of annual acute and chronic monitoring is recommended because Mukwonago is a major municipal discharger with a design flow greater than 1.0 MGD. Federal regulations at 40 CFR Part

122.21(j) require at least 4 acute and chronic WET tests with each permit application on samples collected since the previous reissuance. Therefore, annual monitoring is recommended in the permit term, so that data will be available for the next permit application.

PART 8 – EXPRESSION OF LIMITS

Revisions to chs. NR 106 and 205, Wis. Adm. Code align Wisconsin's water quality-based effluent limits with 40 CFR 122.45(d), which requires WPDES permits contain the following concentration limits, whenever practicable and necessary to protect water quality:

- Weekly average and monthly average limitations for continuous discharges subject to ch. NR 210.
- Daily maximum and monthly average limitations for all other discharges.

Mukwonago is a municipal treatment facility and is therefore subject to weekly average and monthly average limitations whenever limitations are determined to be necessary.

This evaluation provides additional limitations necessary to comply with the expression of limits in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Code. Pollutants already compliant with these rules or that have an approved impracticability demonstration, are excluded from this evaluation including water-quality based effluent limitations for phosphorus, temperature, and pH, among other parameters. Mass limitations are not subject to the limit expression requirements if concentrations limits are given.

Method for calculation:

The methods for calculating limitations for continuous discharges subject to ch. NR 210 to conform to 40 CFR 122.45(d) are specified in s. NR 106.07(3), Wis. Adm. Code, and are as follows:

1. Whenever a daily maximum limitation is determined necessary to protect water quality, a weekly and monthly average limitation shall also be included in the permit and set equal to the daily maximum limit unless a more restrictive limit is already determined necessary to protect water quality.
2. Whenever a weekly average limitation is determined necessary to protect water quality, a monthly average limitation shall also be included in the permit and set equal to the weekly average limit unless a more restrictive limit is already determined necessary to protect water quality.
3. Whenever a monthly average limitation is determined necessary to protect water quality, a weekly average limit shall be calculated using the following procedure and included in the permit unless a more restrictive limit is already determined necessary to protect water quality:

$$\text{Weekly Average Limitation} = (\text{Monthly Average Limitation} \times \text{MF})$$

Where:

MF= Multiplication factor as defined in Table 1

CV= coefficient of variation (CV) as calculated in s. NR 106.07(5m)

n= the number of samples per month required in the permit

s. NR 106.07 (3) (e) 4. Table 1 — Multiplication Factor (for CV = 0.6)

CV	n=1	n=2	n=3	n=4	n=8	n=12	n=16	n=20	n=24	n=30
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Attachment #1

0.6	1.00	1.31	1.51	1.64	1.95	2.12	2.23	2.30	2.36	2.43
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Note: This methodology is based on the *Technical Support Document for Water Quality-based Toxics Control* (March 1991). PB91-127415.

- A weekly geometric mean fecal coliform limit of 656#/100mL is recommended in the permit. This limit is calculated using the default CV of 0.6 and multiplication factor of 1.64 based on an assumed monitoring frequency of once per week.
- The ammonia nitrogen weekly averages for April – September and the monthly average for May – September were set equal to the daily maximum limit because it is more restrictive than the calculated weekly and monthly limits.

Summary of Additional Limitations:

In conclusion, the following additional limitations are required to comply with ss. NR 106.07 and NR 205.065(7) Expression of Limits.

Parameter	Daily Maximum	Weekly Average	Monthly Average	Weekly Geometric Mean	Monthly Geometric Mean	Multiplication Factor (CV)	Assumed Monitoring Frequency (n)
Ammonia Nitrogen November – March April	20 mg/L 20 mg/L	20 mg/L 20 mg/L	20 mg/L 20 mg/L				
Fecal Coliform				656 #/100mL	400 #/100mL	1.64 (0.6)	Weekly (4)

Attachment #3

Temperature limits for receiving waters with unidirectional flow

(calculation using default ambient temperature data)

Facility:	Mukwonago WWTP	7-Q₁₀:	33.00 cfs	Temp Dates	
Outfall(s):	001	Dilution:	25%	Start:	12/01/13
Date Prepared:	1/14/2020	f:	0	End:	11/30/19
Design Flow (Q_e):	1.50 MGD	Stream type:	Small warm water sport or forage fish co ▼		
Storm Sewer Dist.	0 ft	Qs:Q_e ratio:	3.6 :1		
		Calculation Needed?	YES		

Month	Water Quality Criteria			Receiving Water Flow Rate (Qs) (cfs)	Representative Highest Effluent Flow Rate (Q _e)		f	Representative Highest Monthly Effluent Temperature		Calculated Effluent Limit	
	T _a (default)	Sub-Lethal WQC	Acute WQC		7-day Rolling Average (Q _{esl})	Daily Maximum Flow Rate (Q _{ea})		Weekly Average	Daily Maximum	Weekly Average Effluent Limitation	Daily Maximum Effluent Limitation
	(°F)	(°F)	(°F)		(MGD)	(MGD)		(°F)	(°F)	(°F)	(°F)
JAN	33	49	76	63.00	1.207	1.270	0	55	68	NA	120
FEB	34	50	76	66.00	1.276	1.540	0	50	53	NA	120
MAR	38	52	77	92.00	1.667	2.190	0	51	63	NA	120
APR	48	55	79	120.00	1.421	1.610	0	54	55	NA	120
MAY	58	65	82	85.00	1.834	2.500	0	58	59	117	120
JUN	66	76	84	52.00	1.269	1.570	0	63	64	NA	120
JUL	69	81	85	39.00	1.550	2.430	0	66	68	NA	120
AUG	67	81	84	42.00	0.949	1.150	0	68	69	NA	120
SEP	60	73	82	43.00	1.359	1.680	0	68	68	NA	120
OCT	50	61	80	50.00	1.721	2.450	0	65	67	113	120
NOV	40	49	77	72.00	1.351	1.700	0	59	60	NA	120
DEC	35	49	76	67.00	1.361	1.770	0	54	56	NA	120

Attachment #3
OUTFALL MAP

